# Dense and randomized storage and coding of information

# Abstract

We describe a method for dense encoding of information. Bennet and Wiesner (Phys. Rev. Lett. 69:2881-2884, 1992), using EPR-pairs, showed that n bits can be encoded by n/2 quantum-bits, from which the original bits can be retrieved. Here, in a completely different (non-quantum) setting, we give a method for more dense encoding: In our method n bits $x_1, x_2, \ldots, x_n$ are mapped by a linear transform B over the 6-element ring $Z_6$ to numbers $z_1, z_2, \ldots, z_t$ from ring $Z_6$ with $t = n^{o(1)}$ (i.e., much fewer numbers) (Quantity $o(1)$ here denotes a positive number which goes to 0 as n goes to infinity), then, by applying another linear transform C to these zi's, we will get back n elements of ring $Z_6$, $x'_1, x'_2, \ldots, x'_n$, where, e.g., $x'_1$ may have the form $x'_1 = x_1 + 3x_2 + 4x_3$. One can get back $x_1$ simply by running through the values of $x_i$ on the set 0,1,2,3,4,5, and noticing that only $x_1$ has period 6, ($3x_2$ has period 2, $4x_3$ has period 3). Our results generalize for any non-prime-power composite number m instead of 6. We also apply this method for fast computation of matrix multiplication and for compacting and extending matrices with linear transforms.